7.0 ADDITIONAL STUDIES AND ENGINEERING

This section identifies additional studies which must be conducted prior to the design phase. We have prepared preliminary work scopes and cost estimates for each additional study identified. In addition, we have provided preliminary design scopes and estimated fees for the canal prism and each of the major structures discussed in Section 4.0. At this stage, the scopes and cost estimates are preliminary and are subject to revisions and negotiation.

7.1 TOPOGRAPHICAL SURVEYS

Accurate topographical surveys are a prerequisite early in the study and preliminary design phases of the overall rehabilitation project. Specifically, these surveys would provide valuable information for the following:

- Existing canal alignment and prism geometry. Known right-of-ways and property ownership could be superimposed on the survey. As stated earlier, the BOR is currently working on the creation of a GIS-based map showing land ownerships, easements, and rights-of-way (ROW).
- Detailed surface information is needed at major structures including all existing and proposed locations for the siphons, checks, wasteways, the diversion dam, and headgates and each hydraulic drop.
- Upslope terrain and geometry needs to be established at all active landslides to reliably model behavior and design corrective measures. Locations of soil borings, piezometers, and slope inclinometers (Section 7.2) should be established. Slope movement reference markers should be installed and monitored by periodic surveying. These markers would be used to monitor slope movement velocity and direction.

Our initial thoughts were to recommend that an aerial topographical survey be completed over the full length of the diversion facilities. The BOR indicated that they have an existing aerial survey completed in 1993. The degree of accuracy, i.e. contour interal, is not known. Discussions with a surveying contractor who performs this service indicated that considerable flight paths would be required to generate a 1-foot contour map due to the steep-sided canals and canal

curvature. In addition, the canal should be free of water, ice and snow to avoid errors. Small-scale surface features would require follow-up, on-the-ground surveying. This type of survey is generally considered a valuable reconnaissance-level planning tool during realignment and relocation considerations of the major structures and canal rehabilitation as well as assisting with future environmental studies.

An aerial topographical survey is a useful reconnaissance tool but cannot replace more accurate, site-specific design surveys required for final design and construction. These more accurate and detailed surveys would be performed using conventional, on-the-ground techniques such as total stations or GPS techniques to facilitate preparation of construction drawings for the major structures and large earthwork phases of the project.

There are only two times of year to conduct the aerial survey: 1) in the spring once the snow cover has melted and prior to canal filling and leafing of adjacent deciduous trees; and 2) in the fall after the canal is drained and prior to snow cover. The canal is typically wetted in the spring with remnant snow drifts still in the canal. Pools of water, and later ice, remain in the canal throughout the off-season. These are problems for an aerial survey but are easily overcome with on-the-ground, conventional surveying methods. Conventional surveying of the interior canal prism would have to be performed during one of the two times described above. Outside the canal prism, surveying could be conducted during the water diversion season.

We have provided cost estimates to conduct a topographical survey from the diversion dam to the Milk River. Expanded coverage would be performed at locations of the major structures and active landslides.

Table 7.1 Estimated Surveying Costs

Item	Aerial Survey	GPS and Total Stations
Aerial Survey	$95,550	---
Establish Ground Control	$23,100	---
Conventional Survey	---	$94,524
Tribal Fees (5%)	$5,950	$4,726
TOTAL	**$124,600**	**$99,250**

We recommend that a copy of the 1993 BOR aerial survey be obtained for reconnaissance studies and that a topographical survey be performed by on-the-ground conventional methods starting in the Fall of 2005.

7.2 ST. MARY RIVER SIPHON LANDSLIDE STUDIES

Background

The BOR has conducted preliminary geotechnical investigations at several locations along the St. Mary Canal as part of the North Central Montana Feasibility Study (2003). Forty-four drill holes were completed between the diversion dam and Drop No. 5. Their locations are summarized below.

Table 7.2.1 Summary of Geotechnical Borings Conducted by BOR

Purpose/Location	# of Drill Holes
Diversion Dam & Headgates	6
Kennedy Creek Check & Wasteway	1
St. Mary Siphon - West Slope	3
St. Mary River Replacement Bridge Foundation	2
Spider Lake Check	1
Potential Spider Lake Dam Site	3
Cow Creek Culvert	1
Halls Coulee Wasteway	1
Halls Coulee Siphon	2 west, 3 east
979+70 Culvert	1
1052+72 Culvert	1
1096 + 93 Culvert	1
1134+68 Culvert	1
1994+29 Culvert	1
Proposed Wasteway (1293+00)	1
Drop No. 1	3
Drop No. 2	3
Drop No. 3	2
Drop No. 4	4
Drop No. 5	3

Conversations with BOR staff (Lloyd Crutchfield) indicate that the purpose of the geotechnical investigations was to provide designers with preliminary subsurface information with respect to reconnaissance level scoping studies. Laboratory testing of samples collected was not performed and design specific geotechnical recommendations were not developed. Mr. Crutchfield indicted that additional drilling and sampling should be conducted once design phases are initiated.

In 1999, three drill holes were bored along the south slope of the St. Mary River Siphon to investigate ongoing slope movements. Preliminary recommendations were provided to stabilize siphon supports.

In general, the geologic setting of the St. Mary Diversion Facilities is described as follows:

- Coarse-grained (gravels, cobbles, & boulders) fluvial and alluvial fan deposits dominant near surface conditions from the diversion dam to nearly Powell Creek (330+69). Relatively shallow Cretaceous-age sedimentary rock is anticipated on the east side of the St. Mary River.

- As the canal "climbs" (relative to the St. Mary River) past Powell Creek, surficial soils are classified as relatively fine-grained glacial and glaciofluvial deposits comprised of lean clay and silty to clayey sand. Depth to the underlying sedimentary bedrock is variable.

- Downstream of the St. Mary River Siphon, fined-grained glacial till blankets underlying Cretaceous and Tertiary-aged sedimentary bedrock. Depth to bedrock is variable and ranges from ±10 feet on the side hills to over 40 feet in the topographically low areas.

From the diversion dam to the last hydraulic drop, BOR staff has identified at least 15 landslides or earth slumps impacting or having the potential to impact the Diversion Facilities. They are listed below.

Table 7.2.2 Summary of Slope Instabilities Associated With Diversion Facilities

Slide Id.	Approximate Station
Camp Nine Slide	N/A
St. Mary River Siphon	N/A
DeWolfe Ranch Slide	650+00
DeWolfe Bridge Slide	675+00
Mid Section 22 Slide	690+00
East Section 22 Slide	710+00
Grizzly Slide	735+00
Big (Deep) Cut Slide	765+00 to 780+00
4th of July Slide	870+00
Halls Coulee Slide Complex	910+00 to 935+00
Gravel Road Bridge Slide	980+00
Martin Slide	1025+00 to 1035+00
Pipeline Slide	1125+00
Drop No. 2 Slide	1500+00
Drop No. 5 Slide	1529+00

The BOR maintains a Landslide Register for all landslide and embankment instabilities impacting BOR projects. For the St. Mary Diversion Facilities, only one slide was listed in the Register prior to 1995. This slide, known as the St. Mary Canal Slide, was a long area extending from approximately Sta. 650+00 to 800+00. No specific slides were delineated. In 1995, this area was replaced with discrete individual slides identified by a local landmark and approximate canal stationing.

In 1995, heavy precipitation triggered many of the former slides. In 1996, two new slides were added to the Register along with the St. Mary River Siphon instabilities. An additional slide was included in the Register in 1997. In 2002, three more slides were added. BOR geologists conduct annual inspections to observe the known slides. In the last three to four years, little significant landslide activity has been observed. To our knowledge, subsurface soils information does not exist for the identified landslides downstream of the St. Mary River Siphon.

Future Geotechnical Investigation and Recommendations

Site specific geotechnical investigations should be performed at all the major replacement structures including the diversion dam and canal headgates, all checks and wasteways, foundations for replacement bridges, the siphon locations and hydraulic drops. In addition, subsurface information is warranted in areas where significant earthwork is anticipated such as canal prism reconstruction, relocation or landslide/embankment stabilization. With the availability of the BOR's geotechnical reconnaissance information, these follow-up investigations could be conducted during the design phase in Fall 2005 or Spring 2006 once locations of replacement structures have been finalized.

However, in our opinion, the subsurface conditions comprising the sideslopes of the St. Mary River Siphon should be investigated and characterized as soon as possible. Siphon movements were observed as early as five years after original construction and have continued to date. We propose to install slope inclinometer casing on both sideslopes of the St. Mary River Valley in the vicinity of the siphon. These devices would allow slope movements to be measured periodically. This data can be reduced and analyzed to establish the depth to the slide plane, slope movement velocities and the seasonal impacts of movements. The primary goal would be to accurately model slide mass behavior so that geotechnical recommendations can be developed to help ensure long-term performance of the replacement siphons. In order to obtain sufficient, useful data, slope inclinometer measurements should be collected monthly for at least 18 months or longer. For our fieldwork, we propose to use an ATV-mounted CME-550X drill rig capable of hollow-stem augering, continuous sampling and rock drilling/coring.

Our proposed scope of work includes the following:

- Install 3 slope inclinometers (SI) on each slope of the St. Mary River Siphon.
- Inclinometers will be extended at least 10 feet into the underlying sandstone and will have an assumed 50-foot depth each.
- Use a continuous sampler, collect Shelby tubes and ring samples.
- Perform index testing, corrosivity testing, consolidation, direct shear testing and unconfined compressions on samples collected.
- Perform monthly SI measurements and data reduction for 18 months.

- Final report will provide summary of results, slope stability analyses using UTEXAS3, and geotechnical recommendations pertaining to siphon replacement alternatives.

The estimated costs are listed below:

Table 7.2.3 Estimated Costs to Conduct Slope Stability Analyses of St. Mary River Siphon Structures

Phase	Task Description	Estimated Engineering Fee
1.	Fieldwork, 6 Slope Inclinometers to 50 Feet Each	$21,520
2.	Laboratory Testing	$6,350
3.	Summary Report w/Recommendations	$2,529
4.	Monthly Measurements w/Data Reduction - 19 Trips @ $2,380/Trip	$45,220
	Subtotal	*$75,619*
	5% Tribal Fees	$3,781
	Total	**$79,400**

7.3 ECONOMIC STUDIES

We believe an economic study (or studies) has merit for the following reasons:

- Provides credence and a factual basis for the significance of the St. Mary Diversion Facilities and the Milk River Basin Irrigation Project on North Central Montana, as well as Montana as a whole,
- Provides credible and non-partisan backup for lobbying support during the request of State and Federal appropriations, and
- Provides justification for a change in the percentage of reimbursable O&M costs that the BOR is currently required to recover from the irrigators. We understand that the BOR is currently working on a similar study.
- Independent economic justification for a Preferred Alternative (project capacity) greater than 850 cfs.

The level and type of economic study to be conducted should be discussed with DNRC and the Working Group. The required scope of work, estimated costs and completion time will all be

directly related to the desired level of study and intended purpose of the final product. The economic studies would support the analysis and selection of a Preferred Alternative (system capacity). Depending on the scope, economic studies can range in cost from $10,000 to over $200,000. For an initial level of study, we recommend $52,500 (includes 5% Tribal fees). We have provided a preliminary scope of work for an initial economic study. This study could be expanded to a higher level of study in the future, if warranted. The preliminary scope includes the following:

- Gather baseline information on the regional economy of the Milk River Basin and economic demand for major water uses including irrigation, municipal and recreational uses.
- Attend several meetings of the St. Mary Rehabilitation Working Group and provide an economic perspective on the Group's tasks, as directed.
- Identify and review existing economic studies, both on the U.S. and Canadian side of the border, relating to the St. Mary/Milk River Project regional economic impact.
- Identify and review existing studies that provide a cost-benefit perspective for all major end uses of the project including irrigation, municipal and recreational.
- Identify and review existing studies relating to the economic dependence on the St. Mary/Milk River Project, by sector for this basin.
- Supplement existing economic studies with updated information on the region and project.
- Develop a detailed scope of work and budget for the next phases of economic studies for the project, including NEPA compliance.

7.4 BASIN HYDROLOGY STUDIES

As mentioned earlier, one of the governing factors affecting the selection of a Preferred Alternative is the availability of water at the diversion dam as a function of time throughout the diversion season. Overall peak conveyance is reported to be 670 cfs due to canal limitations. Peak diversion is approximately 720 to 750 cfs to account for seepage losses in the first 9 miles of the canal. Hydrologic basin studies are proposed for the St. Mary River and North Fork of the

Milk River as they relate to the diversion and conveyance of water. Areas of study would include developing an unencumbered hydrograph of the natural flows of the St. Mary River downstream of the diversion dam at the U.S-Canadian border. This information would be compared to seasonal releases from Sherbourne Dam. The data would be reviewed to determine the optimum-sized canal to take advantage of flows which exceed current diversion capabilities.

Also, the potential canal inflows would be quantified to determine the advantage of an oversized canal to intercept and convey this unregulated water. Currently, BOR staff monitor potential precipitation events as much as three days in advance in order to reduce diversion and create canal freeboard for the potential stormwater inflows. Opportunity to maximize water diversion is lost, especially if the anticipated storm event does not fully materialize. A properly sized canal would allow reasonable inflows without altering the diversion potential.

In addition, diversion and conveyance capacity has historically diminished over the years. It would be prudent to investigate the impact of increased diversion flows, especially in excess of 850 cfs, on the current condition of the North Fork and main Milk River channel from Drop No. 5 to Fresno Reservoir.

Our proposed scope of work would develop an understanding of the basin hydrology for both the St. Mary River and the North Fork of the Milk River with respect to their impact on optimizing diversion and conveyance flows and the ultimate decision of selecting a Preferred Alternative. Our scope includes the following:

- Review all USGS stream flow data as well as data from the Water Survey Division of Environment Canada pertaining to the St. Mary River in the U.S. and Milk River conveyance channel downstream to Fresno Dam.
- Interview BOR staff with respect to historical operations of Sherbourne Dam and the St. Mary Diversion Facilities.
- Establish flow models of stream flow and potential canal inflows in order to evaluate optimum canal size.

- Assess the Milk River conveyance channel from Drop No. 5 to Fresno Dam in order to develop a professional opinion regarding the conveyance of diverted flows in excess of 850 cfs.

The estimated cost for this study is provided in the table below. We anticipate this study would take approximately 3 months and would be used to support selection of the Preferred Alternative.

Table 7.4 Estimated Cost for Basin Hydrology Studies

Phase	Task Description	Estimated Engineering Fee
1.	Review Existing Stream Flow Data & BOR Records	$6,560
2.	Develop Flow Models and Hydrographs	$5,628
3.	Assess Milk River Conveyance	$3,444
4.	Summary Report	$3,225
	Subtotal	*$18,857*
	5% Tribal Fees	$943
	TOTAL	**$19,800**

7.5 HYDROPOWER FEASIBILITY STUDY

This study involves evaluation of the feasibility of a hydropower facility to replace one or more of the existing drop structures and canal sections between the five drops. The following subtasks will be completed to compare the alternatives for the hydropower facility:

- Collect and review existing data and establish minimum, maximum and average monthly flows and a flow duration curve.
- Estimate the location, length and size of penstock(s) required based on assumed maximum velocity. Estimate head losses and net head available for energy generation based on the penstock arrangement and flow duration curve.
- Analyze projected flow and pressure data, develop a flow versus head curve and select the type of unit most applicable to the site based on available literature.
- Develop a conceptual project arrangement for the selected turbine and generator type and prepare the following conceptual drawings:
  - Powerhouse and switchyard plan (topography will not be included)

  - Powerhouse conceptual arrangement and cross section(s)
  - Single line diagram of power facilities from generator to transmission line
- Perform power studies to estimate the amount of power and energy that can be generated.
- Consider potential, mutually beneficial impacts of Blackfeet Wind Farm proposed northeast of Duck Lake.
- Approximate the distance to the nearest power transmission line (U.S. or Canada) and estimate construction costs for the transmission line and interconnection facilities, if required.
- Estimate costs for mobilization, demolition, site work, structures, equipment, penstocks, switchyard, contingencies, engineering and administration and interest during construction and calculate the total investment cost.
- Estimate annual operation and maintenance costs based on our experience and data from other existing small hydroelectric facilities.
- Establish the rates for energy and annual cost for debt service and perform an economic analysis to determine the return on the investment.
- Prepare a feasibility report to document the tasks completed and present the results, conclusions and recommendations.

The budgetary cost estimate to complete the Hydropower Feasibility Study is $40,450 (includes 5% Tribal fees) and is estimated to take three months.

7.6 PREFERRED ALTERNATIVE SELECTION STUDY

This first major design decision, which must be made towards the goal of overall project rehabilitation, is the desired or optimum capacity (Preferred Alternative) of diversion and conveyance to the North Fork of the Milk River. Current BOR studies (BOR, 2004) have discussed alternatives for alleviating documented water shortages in the Milk River Basin from Havre to Glasgow. Their studies indicate that rehabilitating the St. Mary Facilities afforded the greatest opportunity towards reestablishing a constant and reliable source of water to the Basin and to reduce water shortages. Four capacities were discussed and include

500 cfs, 670 cfs, 850 cfs and 1000 cfs. However, a final recommendation and supporting documentation has not been made.

We propose a study to assist DNRC and the Working Group select a Preferred Alternative so that funding can be obtained and the environmental and engineering studies can commence. The Preferred Alternative Study scope of work would include the following:

- Utilize the results of the Basin Hydrology Study (Section 7.4) to assess water availability versus time relationships, as well as other findings discussed above.
- Utilize results of economic studies (Section 7.3) to assess cost-benefit relationships for various system capacities.
- Review IJC 1921 order and water balance accounting procedures. The IJC's Administrative Measures Task Force Interim Report is expected March 28, 2005 with the Final Report due June 30, 2005.
- Review BOR maintenance and operation records regarding historical releases from Sherbourne Dam and canal diversions.
- Review BOR-prepared land ownership, easement records and ROWs to determine land availability for larger canals and related structures. The BOR is currently preparing this information in a GIS-format, and it is our understanding that it will be available in March or April of 2005.
- Prepare a final report summarizing the background information and findings, and provide a recommended Preferred Alternative to the Working Group for consideration.

The budgetary cost estimate to complete the Preferred Alternative Study is $44,650, which includes 5% for Tribal fees and would take approximately 5.5 months.

7.7 ENGINEERING OF INDIVIDUAL STRUCTURES

Engineering services are required for the individual components comprising the St. Mary Facilities. These services would be completed in three phases: 1) Feasibility/Design Studies, 2) Final Design, and 3) Construction Administration. Design studies are required to determine the most practical replacement or rehabilitation option. The final design phase would detail the

selected replacement option, and final construction drawings and specifications would be prepared. Construction administration involves assistance during the bidding phase, construction management and construction inspection services. At this current stage, the scopes of work and estimated fees are preliminary in nature and are intended for budgetary purposes. Once recommended replacement options are selected from the Feasibility/Design Studies, we can provide more accurate estimates for design and construction management fees.

7.7.1 Diversion Dam and Canal Headgates

Engineering services for the diversion dam and canal headgates would include the following:

- Follow-up geotechnical and survey data, as needed.
- Assess river flow regime and diversion backwater relationships,
- Evaluate fish passage options,
- Determine diversion dam, crest control, headgate and sluiceway options (look at other alternatives),
- Evaluate fish screening alternatives,
- Design automation, instrumentation, and remote-control package,
- Prepare feasibility report with options, estimated costs and recommendations,
- Prepare final design drawings, specifications and revised construction costs,
- Assist with Contractor solicitation,
- Review shop drawings and submittals,
- Perform construction administration and inspection,
- Provide project close-out report and record drawings.

The estimated engineering fees for the diversion dam and headgates are shown below.

Table 7.7.1 Estimated Design Fees for the Diversion Dam and Canal Headgates

Phase	Task Description	Estimated Engineering Fee
1.	Preparation of Design Criteria, Preliminary Design, Cost Estimate, and Preliminary Engineering Report.	$120,000
2.	Detailed Designs, Including Final Drawings and Specifications	$630,000
3.	Construction Management Services	$1,400,000
	Subtotal	*$2,150,000*
	5% Tribal Fees	$107,500
	ESTIMATED TOTAL	**$2,257,500**

7.7.2 Kennedy Creek Siphon

Engineering services for the Kennedy Creek Siphon replacement would include the following:

- Follow-up geotechnical and survey data, as needed.
- Determine optimum layout and siphon geometry for Preferred Alternative flows,
- Structural engineering for reinforced concrete sections,
- Review geomorphology of Kennedy Creek with respect to siphon performance and bull trout issues,
- Prepare feasibility report with options, estimated costs and recommendations,
- Prepare final design drawings, specifications and revised construction costs,
- Assist with Contractor solicitation,
- Review shop drawings and submittals,
- Perform construction administration and inspection,
- Provide project close-out report and record drawings.

Table 7.7.2 Estimated Design Fees for Kennedy Creek Siphon

Phase	Task Description	Estimated Engineering Fee
1.	Preparation of Design Criteria, Preliminary Design, Cost Estimate, and Preliminary Engineering Report.	$30,000
2.	Detailed Designs, Including Final Drawings and Specifications	$110,000
3.	Construction Management Services	$160,000
	Subtotal	*$300,000*
	5% Tribal Fees	$15,000
	ESTIMATED TOTAL	**$315,000**

7.7.3 St. Mary River and Halls Coulee Siphons

The recommended Scope of Work associated with both major siphon installations is listed as follows:

- Perform additional geotechnical investigations and surveying in the areas of the St. Mary River Siphon and the Halls Coulee Siphon,
- Upgrade cost estimates for alternatives which were previously investigated,
- Prepare cost estimates for newly identified alternatives in this report,
- Prepare preliminary design sketches for the preferred alternatives,
- Prepare preliminary cost estimates of the preferred alternatives,
- Prepare preliminary engineering report, recommending the alternatives to accept for Detailed Design,
- Prepare final design drawings and specifications,
- Assist with Contractor solicitation,
- Perform construction management services.

Table 7.7.3 Estimated Design Fees for St. Mary River and Halls Coulee Siphons

Phase	Task Description	Estimated Engineering Fee
1.	Preparation of Design Criteria, Preliminary Design, Cost Estimate, and Preliminary Engineering Report	$230,000
2.	Detailed Designs, Including Final Drawings and Specifications	$800,000
3.	Construction Management Services	$1,550,000
	Subtotal	*$2,580,000*
	5% Tribal Fee	$129,000
	ESTIMATE TOTAL	**$2,709,000**

7.7.4 Canal Check & Wasteway Structures

The recommended Scope of Work associated with the siphons is listed as follows:

- Perform geotechnical investigations and topo surveys as required,
- Determine optimum layout and geometry for Preferred Alternative flows,
- Design automation, instrumentation and remote-control package,
- Structural engineering for reinforced concrete sections,
- Prepare feasibility report with options, estimated costs and recommendations,

- Prepare final design drawings, specifications and revised construction costs,
- Assist with Contractor solicitation,
- Review shop drawings and submittals,
- Provide project close-out report and record drawings,
- Prepare final design drawings and specifications,
- Assist with Contractor solicitation,
- Perform construction management services.

Table 7.7.4 Estimated Design Fees for Kennedy Creek and Halls Coulee Check and Wasteway Structures

Phase	Task Description	Estimated Engineering Fee
1.	Preparation of Design Criteria, Preliminary Design, Cost Estimate, and Preliminary Engineering Report	$70,000
2.	Detailed Designs, Including Final Drawings and Specifications	$277,000
3.	Construction Management Services	$423,000
	Subtotal	*$770,000*
	5% Tribal Fee	$38,500
	ESTIMATE TOTAL	**$808,500**

7.7.5 Hydraulic Drop Structures

Several alternatives exist to address the current condition of the drop structures. Regardless of the approach, it is essential to provide a structure that will contain the maximum flow that occurs in the canal, as compared to the present situation. Prerequisites to designing the replacement drop structures, are to determine the desired flow capacity of the canal (Preferred Alternative, Section 7.6) and the feasibility of hydropower (Section 7.5).

The following scope of work should be performed:

- Evaluate the various structure configurations, including in-kind replacement, or replacement with baffled apron drop, pipe drop, or chute with stilling basin.
- Determine required cross-sections, overall structure dimensions, and structure layout for the alternate structures.
- Evaluate methods to reduce snow/ice buildup within the transition to the drop during initial system filling.

- Evaluate and address safety (including guardrail, chute entrance, etc.) and access (including bridge crossing) considerations.
- Evaluate whether replacement structure should be located in same location as existing or adjacent to existing structure.
- Evaluate location of replacement structure relative to property boundary and available space, if located adjacent to existing structure.
- Evaluate types of energy dissipation to be used.
- Evaluate foundation properties and surface geology mapping.
- Evaluate potential required modifications to the canal sections between the drop structures.
- Develop conceptual level drawings, including plan, elevation and typical cross sections.
- Perform detailed review of existing BOR construction cost estimates for the three above mentioned structure configurations and update as necessary. Develop additional conceptual level construction cost estimates for additional alternative designs.
- Prepare final drawings and specifications.
- Assist with Contractor solicitation.
- Provide construction management and inspection services.

Table 7.7.5 Estimated Design Fees for Hydraulic Drop Nos. 1 Through No. 5

Phase	Task Description	Estimated Engineering Fee
1.	Preparation of Design Criteria, Preliminary Design, Cost Estimate, and Preliminary Engineering Report.	$130,000
2.	Detailed Designs, Including Final Drawings and Specifications*	$303,000
3.	Construction Management Services	$650,000
	Subtotal	*$1,083,000*
	5% Tribal Fee	$54,150
	ESTIMATE TOTAL	**$1,137,150***

*Does not include cost for design of hydropower machinery.

7.7.6 Canal Prism Rehabilitation

The recommended Scope of Work is provided for the reach of canal from the diversion dam to Drop No. 5. It is likely the canal rehabilitation will require at least 6 separate construction projects due to the limited construction season and the need to not interrupt the normal water diversion season.

It was assumed that the following information will be available:

- Plans showing the existing land ownership and right-of-way for the canal and related structures.
- Costs per acre of acquiring additional right-of-way and construction easements.

The Scope of Work is the following:

- Conduct additional geotechnical investigations.
- Plan and arrange for preparation of plan-profile drawings for the individual reaches of the canal.
- Prepare Design Criteria for rehabilitation of the canal. Included in this task is consideration of the following:
  - Design flow rate
  - Manning's "n" for the canal
  - Existing canal design elements
  - New canal design elements
  - Freeboard requirements. To determine freeboard, consideration needs to be given to drainage inflows, and wasteway requirements, as well as conveying the design flow rate.
  - Considerations for a two-bank canal or one-bank canal.
- Considerations for gravel armoring.
- Whether road gravel is to be provided on both the driving banks and maintenance bank or just driving bank.
- Criteria for straightening various reaches of the canal. This could be a combination of general straightening of the existing canal as well as longer relocations of the canal which would in turn generate the required borrow material.

- Criteria for designing the parts of the canal where landslides have occurred or are in danger of occurring.
- Criteria related to canal maintenance requirements.
- Type of drainage structures. This could be cross drains or drain inlet structures.
- Criteria for determining design flow rates for drainage structures.
- Incorporating Blackfeet environmental and cultural concerns.
- Type of turnout structures.
- Type of check or check/drop structures and control gates.
- Type of wasteway structure, including design discharge rate.
- Number and type of canal crossings.
- Fencing and livestock watering issues.
- Type of seepage control, if required.
- Prepare preliminary plan-profile drawings of the new canal.
- Prepare typical cross-sections of the new canal design.
- Prepare preliminary sketches of canal structures.
- Prepare preliminary cost estimate of the canal rehabilitation work.
- Prepare cost estimate of additional right-of-way required, including construction easements.
- Prepare preliminary engineering report.
- Prepare final construction drawings and specifications.
- Assist with Contractor solicitation.
- Perform construction administration and inspection services.

Table 7.7.6 Estimated Design Fees for Overall Canal Prism Rehabilitation

Phase	Task Description	Estimated Engineering Fee
1.	Preparation of Design Criteria, Preliminary Design, Cost Estimate, and Preliminary Engineering Report.	$850,000
2.	Detailed Designs, Including Final Drawings and Specifications	$2,650,000
3.	Construction Management Services	$4,000,000
	Subtotal	*$7,500,000*
	5% Tribal Fee	$375,000
	ESTIMATE TOTAL	**$7,875,000**

Note: Assumes Multiple Reaches and Separate Construction Contracts